

What is claimed is:

1. A filter assembly comprising

a housing defining an interior chamber and including an inlet, an outlet, and a fluid pathway for a liquid flowing through the interior chamber wherein the liquid flowing through a first region of the interior chamber generates a first fluid pressure and a second fluid pressure lower than the first fluid pressure through a second region of the interior chamber;

a filter element disposed in the interior chamber in the fluid pathway between the inlet and the outlet;

a first container disposed within the interior chamber and having an exterior wall defining an interior region, said container having a first opening including a first capillary tube extending from the exterior wall and a second opening through the exterior wall spaced apart from the first opening, said first opening and said second opening providing fluid communication between the interior chamber and the interior region; and

a liquid additive provided in the interior region, said additive selected to provide a beneficial property to the liquid flowing through the filter assembly.

2. The filter assembly of claim 1 wherein the first capillary tube provides direct fluid communication to the first region.

3. The filter assembly of claim 1 wherein the first capillary tube extends into the interior region of the container.

4. The filter assembly of claim 3 wherein the first capillary tube extends from the exterior surface of the container and terminates adjacent the filter element.

5. The filter assembly of claim 4 wherein the first capillary tube is configured to extend between the filter element and the outer casing.

6. The filter assembly of claim 5 wherein the filter element is provided as a cylindrical sleeve of a porous material having a first length measured along an axis of the

cylindrical sleeve and wherein the first capillary tube extends from the first container and has a length substantially equal to the first length.

7. The filter assembly of claim 5 wherein the filter element is provided as a cylindrical sleeve of a porous material having a first length measured along an axis of the cylindrical sleeve, and wherein the first capillary tube extends from the first container and has a length less than or equal to about three-fourths of the first length.

8. The filter assembly of claim 7 wherein the first capillary tube extends from the first container and has a length less than or equal to about one-half of the first length.

9. The filter assembly of claim 7 wherein first capillary tube extends from the first container and has a length less than or equal to about one-fourth of the first length.

10. The filter assembly of claim 1 wherein the first container has a top wall portion including the first opening and an opposite bottom wall portion and wherein the first capillary tube extends into the interior region substantially to the bottom wall.

11. The filter assembly of claim 10 wherein the first container has a depth measured from the top wall portion to the bottom wall portion and wherein the second opening includes a second capillary tube extending into the interior region a first distance less than or equal about one fourth of the depth.

12. The filter assembly of claim 1 wherein the first container has a top wall portion including the first opening and an opposite bottom wall portion and a depth measured from the top wall portion to the bottom wall portion and wherein the first capillary tube extends into the interior region a first distance less than or equal about one fourth of the depth.

13. The filter assembly of claim 12 wherein the second opening includes a second capillary tube extending into the interior region a first distance greater than or equal about three fourths of the depth

14. The filter assembly of claim 1 wherein the second opening provides direct fluid communication with the second region of the interior chamber.

5 15. The filter assembly of claim 1 wherein the second opening comprises a second capillary tube.

16. The filter assembly of claim 15 wherein the container includes a top wall and the second capillary tube is molded into the top wall of the container.

10 17. The filter assembly of claim 15 wherein the first capillary tube has a first diameter and the second capillary tube has a second diameter smaller than the first diameter.

15 18. The filter assembly of claim 15 wherein the first capillary tube has a first diameter and the second capillary tube has a second diameter greater than the first diameter.

19. The filter assembly of claim 15 wherein the first capillary tube has a first length and the second capillary tube has a second length different from the first length.

20 20. The filter assembly of claim 15 wherein the second capillary tube comprises one of a filter, a porous membrane, or a soluble element covering its end.

21. The filter assembly of claim 1 wherein the first capillary tube comprises one of a filter, a porous membrane, or a soluble element covering its end.

25 22. The filter assembly of claim 1 wherein the filter element partitions the interior chamber into a liquid entering region and a liquid exiting region and wherein the first region is located in the entering region and the second region is located in the exiting region.

30 23. The filter assembly of claim 22 wherein the first capillary tube extends into the first region.

24. The filter assembly of claim 22 wherein the second opening provides direct fluid communication with the interior region and the second region.

5 25. The filter assembly of claim 24 wherein second opening comprises a second capillary tube having an end positioned in the second region and including one of a filter, a porous membrane, or a soluble element covering the end of the second capillary tube.

10 26. The filter assembly of claim 1 wherein filter element partitions the interior chamber into an entering region and an exiting region and wherein the first region and the second region are located in the entering region.

15 27. The filter assembly of claim 26 wherein the first capillary tube extends into the first region.

28. The filter assembly of claim 26 wherein the second opening provides direct fluid communication with between the interior region and the second region.

20 29. The filter assembly of claim 1 comprising a flow-directing insert disposed in the interior region of the first container.

30. The filter assembly of claim 29 wherein the flow-directing insert comprising a spiral partition.

25 31. The filter assembly of claim 29 wherein the flow-directing insert comprises ribs or fins.

30 32. The filter assembly of claim 1 wherein first container is cylindrical defining a central axis and the first opening is spaced from the central axis.

33. The filter assembly of claim 1 comprising a second container as a reservoir for a second additive.

34. The filter assembly of claim 33 wherein the second container is positioned between the filter element and the first container.

35. The filter assembly of claim 34 wherein the container includes a top wall and the second opening includes a second capillary tube molded into the top wall of the container and extending through the second container.

36. The filter assembly of claim 1 wherein the first capillary tube has a first end having an elliptical or oval configuration.

37. The filter assembly of claim 1 comprising a nutplate and a filter endcap positioned between the filter element and the nutplate, said endcap including a shroud terminating adjacent an end of the first capillary tube.

38. The filter assembly of claim 1 wherein the exterior wall of the container comprises spacers or ribs.

39. A filter assembly comprising  
a housing defining an interior chamber and including an inlet and an outlet into the interior chamber;

a filter element disposed in the interior chamber between the inlet and the outlet, said  
5 filter element partitioning the interior chamber into an entering region proximate to the inlet and an exiting region proximate to the outlet;

a first container disposed within the interior chamber and defining an interior region, said  
first container having a first capillary tube extending into the entering region and a second  
capillary tube providing fluid communication between the interior region and the interior  
10 chamber; and

a liquid additive provided in the interior region, said liquid additive selected to provide at least one benefit to the liquid flowing through the filter assembly.

40. The filter assembly of claim 39 wherein the first capillary tube extends from the  
15 first container into the entering region and terminates adjacent the filter element.

41. The filter assembly of claim 40 wherein the first capillary tube is configured to extend between the filter element and the housing.

42. The filter assembly of claim 39 wherein the first capillary tube has a first end  
20 having an elliptical or oval configuration.

43. The filter assembly of claim 39 comprising an nutplate and a filter endcap positioned between the filter element and the nutplate, said endcap including a shroud  
25 terminating adjacent an end of the first capillary tube.

44. The filter assembly of claim 39 wherein the filter element is provided as a cylindrical sleeve of a porous material having a first length measured along an axis of the cylindrical sleeve and wherein the first capillary tube extends from the first container and has a  
30 length substantially equal to the first length

45. The filter assembly of claim 39 wherein the filter element is provided as a cylindrical sleeve of a porous material having a first length measured along an axis of the cylindrical sleeve, and wherein the first capillary tube extends from the first container and has a length less than or equal to about three-fourths of the first length.

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46. The filter assembly of claim 45 wherein the first capillary tube extends from the first container and has a length less than or equal to about one-half of the first length.

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47. The filter assembly of claim 46 wherein first capillary tube extends from the first container and has a length less than or equal to about one-fourth of the first length.

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48. The filter assembly of claim 39 wherein the first container has a top wall portion including the first opening and an opposite bottom wall portion and wherein the first capillary tube extends into the interior region substantially to the bottom wall.

49. The filter assembly of claim 39 wherein the first container has a depth measured from the top wall portion to the bottom wall portion and wherein the second capillary tube extends into the interior region a first distance less than or equal about one fourth of the depth.

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50. The filter assembly of claim 39 wherein the first container has a top wall portion including the first opening and an opposite bottom wall portion and a depth measured from the top wall portion to the bottom wall portion and wherein the first capillary tube extends into the interior region a first distance less than or equal about one fourth of the depth.

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51. The filter assembly of claim 50 wherein the second capillary tube extends into the interior region a first distance greater than or equal about three fourths of the depth.

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52. The filter assembly of claim 39 wherein the first capillary tube has a first diameter and the second capillary tube has a second diameter different than the first diameter.

53. The filter assembly of claim 39 wherein the first capillary tube has a first length and the second capillary tube has a second length different from the first length.

5 54. The filter assembly of claim 39 comprising a flow-directing insert disposed in the interior region of the container.

55. The filter assembly of claim 54 wherein the flow-directing insert comprises a spiral partition.

10 56. The filter assembly of claim 54 wherein the flow-directing insert comprises ribs or fins.

57. The filter assembly of claim 39 wherein first container is cylindrical defining a central axis and the first opening is spaced from the central axis.

15 58. The filter assembly of claim 57 wherein the second opening is positioned in line with the central axis.

20 59. The filter assembly of claim 39 comprising a second container as a reservoir for a second liquid additive.

60. The filter assembly of claim 59 wherein the second container is positioned between the filter element and the first container.



61. A method of supplying an additive to a liquid flowing through a filter assembly, said method comprising:

generating a dynamic fluid pressure gradient within the filter assembly;

providing a liquid additive in a container within the filter assembly;

5 positioning an inlet port for the container proximate to an area of a first dynamic fluid pressure within the filter assembly; and

positioning an outlet port for the container proximate to an area of a second dynamic fluid pressure less than the first dynamic fluid pressure, said outlet port allowing the liquid additive to flow out of the container.

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